Developing a Comprehensive Human Systems Integration (HSI) Requirements Standard Repository for Use in the Acquisition of DoD Systems

DoD Human Factors Engineering Technical Advisory Group
Meeting 68
Aberdeen Proving Grounds

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HFE/HSI Experience

- Education:
  - B.S. in Human Factors Psychology (Engineering), Embry-Riddle Aeronautical University
  - Masters in Human Systems Integration, Naval Postgraduate School

- 10 Years Engineering Experience on Army and Marine Corps Programs
  - System Safety Engineering
  - Human Factors Engineering
    - GUI Design
    - Anthropometric Modeling
    - Task & Workload Analysis
  - Warfighter Survivability Analysis and Testing
    - System Live Fire Testing (Anthropomorphic Test Dummies)
    - Mineblast Seat Drop Testing
  - Human Systems Integration Project Management

- Primary platforms:
  - Abrams MBT
  - Stryker ACV
  - Stryker DVH

Evaluating HSI Requirements

HFE & HSI requirements hold little leverage amongst hardware and software engineers and are seen as mere ‘guidelines’ by engineering leads and project managers.

Contractors won’t consider HSI requirements in their design of a system unless the requirements are clearly specified as contractual obligations (this is considered scope creep).

PMs have stated that current contract requirement specifications do not provide specific means for evaluating human performance in systems design and testing; therefore, it’s not held as a constraint in the design tradeoffs, but instead a ‘nice to have’.

Requirements from MIL-STD-1472 are not measureable or testable; HSI testing is not developed enough that we have standardized test cases that can be used for measuring performance.

Typical HFE Contract Requirements Language:

- The system shall comply with the specifications of MIL-STD-1472
- The system shall be designed to accommodate the 5th-95th percentile

Evaluating HSI Requirements

Current HSI Requirement Standards:

- fail to provide traceability of requirements
- fail to provide source of performance data
- contain outdated information and lack details of current technology
- contain shall statements that are directed at HFE designers rather than the system being designed
- are not measureable or testable
- are organized poorly and do not divide HSI domains into subsections
- have not been updated to address lessons learned in OIF/OEF
- contradict themselves
- can be convoluted and difficult to follow

Additional areas not covered in current requirements include:

- User Equipment Lists
- Updated CONOPS
- Updated Load Lists
- HSI Test Cases
- Digital human models that represent the user/maintainer audience

Examples of the Impact on Design

1. Stryker ACV driver's seat is off-center from the station's midline, console and steering wheel
   - FBCB2 placed behind steering wheel
   - Seat cushion of mine-resistant seat 'bottoming-out' resulting in "dead legs" within ten minutes of seated operations
   - Crewmen could not operate aft seat drop mechanism used when extracting the Driver from his station
   - Seat did not accommodate body armor

   Problem: Requirements weren't specifically spelled out in contract stating centered design of seat and instead this was traded for ease of integration; there was no cushion test data available to specify the cushion design and no HFE testing conducted on the seat (an HRL scale would have been beneficial for this)

2. Stryker DVH Medical Evacuation Vehicle (MEV) redesign relocated saline and blood warmer to 'roof'
   - Load list indicated MRE heater as non-essential; engineers relocated system outside the vehicle in stowage area
   - Interviews with Medics at Ft. Sam Houston yielded information that was invalid in documents provided by stakeholders; MRE heater is actually being used as a saline and blood warmer

   Problem: No user input provided in redesign of Stryker ACV FOV for DVH configuration; no formal HSI requirements specified on contract; load list not kept up-to-date

3. Anthropometric Modeling of vehicle integration fails to accommodate user equipment
   - Legacy systems not developed with present day PPE in mind; crew-stations unable to accommodate full range of users

   Problem: Digital models are outdated and fail to equip engineers with representative manikins and PPE required for operations and maintenance

Additional Impacts to Design

Contractors spend so much time and manpower working on, arguing and justifying requirements early on in the planning stage that many HSI analyses that should take place up-front are pulled in later

- The design is sometimes too advanced for modifications without significant impact to program schedule and cost
- Results in sub-standard design and higher risk of identifying critical issues during user testing and system fielding

Proposed Effort

- Create a joint-service collaboration initiative that incorporates SMEs from all branches of service and includes contract engineers in conjunction with federal civil service and active duty personnel
  - Compile data from lessons learned in OIF/OEF as well as DoD programs for incorporation into an HSI requirements standard

- Develop a comprehensive HSI requirements repository that can be tailored (via queries) to address individual program needs early in the acquisition process
  - Re-write HSI requirements to statements that quantifying system- and subsystem-level performance parameters
  - Incorporate data from current standards and specifications including all domains of HSI
  - Create links that trace requirements to their origins
  - Develop test cases that measure operational effectiveness and link to requirements
  - Create a search/query function that makes searching for requirements and test cases easy
  - Create a searchable database that tracks testing, analyses and resulting artifacts
  - Document specific tools and materials required for war-fighter design (i.e., personnel equipment part numbers, user and maintainer's anthropometric dimensions)

Example Tools

- IBM Collaborative Lifecycle Management (CLM) Solutions
  - Doors or Requirement Composer (RRC)
  - Rational Team Concert (RTC)
  - Rational Quality Manager (RQM)

Closing

- A formal HSI requirements repository allows for the incorporation of HSI domains early in the acquisition process, resulting in a true war-fighter centered approach to systems design

- Additional benefits include:
  - reduced likelihood of unexpected design modifications
  - reduced burden of tracking requirements (allows for a hierarchical modularized approach that drives direct tracing of requirements to detailed design)
  - increased testing and analysis execution and tracking
  - streamlined analysis of alternatives and input to